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EFFECT OF TEMPERATURE AND RELATIVE HUMIDITY ON CERTAIN LIFE HISTORY TRAITS IN *ANTHERAEA MYLITTA* (SATURNIIDAE)

Additional key words: climate, tasar silk moth, emergence, seasonal variability.

Antheraea mylitta (Drury), the semi-domesticated tasar silk moth, produces three generations annually under commercial rearing conditions, i.e., July–August (rain), September–October (autumn), and November–December (winter). Eggs for commercial rearings are collected from mated females from the grainage—a specially designed, well ventilated house for storage of tasar silk moth cocoons. Emergence of moths occurs from diapausing pupae immediately before each of the rearing seasons. Diapause in the first generation (rain) lasts up to 15 days; that of the second generation (autumn) lasts up to 20 days; and that of the third generation (winter) lasts nearly 150 days. Life history features such as percent emergence, percent coupling, fecundity, and percent hatching of *A. mylitta* are variable between seasons. Some of this variation appears to be influenced by climatic conditions; Jolly et al. (1974) and Nayak and Dash (1989) have demonstrated the influence of climatological factors on reproduction in *A. mylitta*. Understanding the effect of environmental factors upon these life history parameters is important for the maintenance of an appropriate reservoir of cocoons for commercial silk production. Hence, we conducted this study to determine and quantify the relationship of temperature and relative humidity to moth emergence, coupling success, fecundity, and hatching.

Healthy cocoons of *A. mylitta* were collected at random from the commercial grainages at the State Tasar Research Farm, Durgapur, Orissa, India. The cocoons were collected in 5 replications of 1000 individuals at the beginning of each month throughout the rearing season in 1988. The cocoons of each replication were stored separately in wire mesh cages inside the grainages. Daily emergence of adults, along with their sex and mating activity (coupling) were recorded. After mating, females were allowed to oviposit in cardboard boxes. Fecundity and percent hatching were recorded each month. Ambient temperature and relative humidity inside the grainage were recorded daily. The data were analyzed statistically to identify correlations between environmental factors and percent emergence, percent coupling, fecundity, and percent hatching. Student's *t*-test

TABLE 1. Mean values \pm SD of temperature and relative humidity (RH) and mean \pm SD of monthly percentage of emergence, percentage of coupling, fecundity and percentage of hatching of *A. mylitta* during 1988.

Season	Month	Temperature \pm S.D.	Relative humidity \pm S.D.	% emergence		% coupling	Fecundity (no.)	% hatching
				Male	Female			
Summer	March	32.1 \pm 1.09	70.8 \pm 3.12	0.17 \pm 0.04	0.11 \pm 0.01	15.23 \pm 0.03	177.66 \pm 0.03	74.66 \pm 0.03
	April	29.6 \pm 0.98	81.8 \pm 2.91	0.07 \pm 0.01	0.07 \pm 0.03	6.66 \pm 0.03	142.57 \pm 0.04	65.44 \pm 0.04
	May	33.4 \pm 1.68	83.8 \pm 3.15	5.38 \pm 0.04	5.31 \pm 0.03	32.12 \pm 0.04	130.46 \pm 0.06	68.73 \pm 0.03
	June	32.1 \pm 1.70	87.9 \pm 2.08	24.02 \pm 0.03	22.55 \pm 0.07	38.83 \pm 0.03	178.45 \pm 0.07	72.43 \pm 0.04
Rainy	July	30.3 \pm 0.88	97.9 \pm 1.99	33.91 \pm 0.03	34.68 \pm 0.03	62.18 \pm 0.03	170.78 \pm 0.03	70.07 \pm 0.04
	August	28.7 \pm 1.16	89.9 \pm 2.01	37.73 \pm 0.04	36.81 \pm 0.03	68.68 \pm 0.03	179.35 \pm 0.07	73.77 \pm 0.04
	September	27.6 \pm 1.99	98.7 \pm 1.78	41.57 \pm 0.04	41.85 \pm 0.03	79.46 \pm 0.06	186.23 \pm 0.03	75.60 \pm 0.03
	October	26.9 \pm 1.31	92.7 \pm 1.93	35.81 \pm 0.04	35.12 \pm 0.06	65.55 \pm 0.07	188.20 \pm 0.07	77.91 \pm 0.04
Winter	November	23.7 \pm 0.09	85.7 \pm 0.89	12.05 \pm 0.01	12.92 \pm 0.03	29.37 \pm 0.04	204.07 \pm 0.04	82.84 \pm 0.03
	December	22.7 \pm 0.81	86.0 \pm 1.02	2.25 \pm 0.01	2.63 \pm 0.04	21.09 \pm 0.03	197.67 \pm 0.04	81.46 \pm 0.03
	January	21.8 \pm 1.01	97.8 \pm 0.95	1.24 \pm 0.04	1.05 \pm 0.04	11.74 \pm 0.04	195.46 \pm 0.03	78.38 \pm 0.04
	February	24.2 \pm 0.98	80.8 \pm 0.88	0.19 \pm 0.03	0.24 \pm 0.04	9.51 \pm 0.01	180.71 \pm 0.03	72.53 \pm 0.02

and Fisher's Z-transformation were performed to evaluate the statistical significance of the correlations (Snedecor & Cochran 1967).

Percent emergence and percent coupling were highest from July through October, when temperature ranged from 27–30°C and relative humidity from 90–98% (Table 1). Percent emergence and percent coupling peaked in September, when average temperature and relative humidity were near their highest, 27.6°C and 98.7%, respectively (Table 1). Percent emergence and percent hatching were lower from November through June (Table 1).

Probability values of the *t*-test demonstrate a statistically significant difference between percent male and female emergence, percent coupling, fecundity, and percent hatching between each season ($P < 0.01$). There is a positive correlation between the climatological factors (monthly temperature and relative humidity) and percent male and female emergence, percent coupling, fecundity, and percent hatching. However, *t*-tests and Fisher's Z-transformation indicated that the correlations are statistically not significant ($P = 0.01$).

The highest percent emergence and percent coupling, recorded in September, may be attributed to temperature (27.6°C) and relative humidity (98.7%), which apparently are optimal during this month and may possibly stimulate the reproductive physiology of the diapausing pupae. The lower percent emergence and percent coupling recorded during November through June might be the result of lower temperatures and lower relative humidity during winter, and higher temperatures and lower relative humidity during summer. The adverse climatological conditions during winter and autumn may cause *A. mylitta* to diapause, resulting in poor emergence and poor coupling during these respective months.

Rogers and West-brook (1985) reported that 10°C temperature caused delayed adult emergence in *Homoeosoma electellum* (Hulst) (Pyralidae) during different years of study. Similarly, Slosser et al. (1984) observed that cooler temperatures during spring resulted in delayed emergences of *Anthonomus grandis* Boheman (Coleoptera: Curculionidae). Jolly et al. (1974) reported that percent emergence and coupling of *A. mylitta* were reduced by low temperature (10°C) and low relative humidity (20%).

We suspect that percent emergence of *A. mylitta* was lower in summer during our experiment because of high temperature coupled with comparatively low relative humidity. This hypothesis corroborates studies by Therrien and McNeil (1985) who observed above normal pupal mortality in *Agromyza frontella* Rond (Diptera: Agromyzidae) under conditions of high temperature and low humidity. We currently are studying the effect of temperature and relative humidity on mortality of diapausing pupae of *A. mylitta*.

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A "HEATHII" ABERRATION OF *MITOURA GRYNEA SWEADNERI*
(LYCAENIDAE: THECLINAE)

Additional key words: Florida, phenotype.

Various types of wing pattern aberrations are known for the Theclinae, including a recurring phenotype with greatly exaggerated white maculation on the ventral wing surfaces. Fletcher (1903, 1904) misinterpreted such an aberrant female specimen of *Satyrium calanus falacer* (Godart) as a new species, describing it as *Thecla heathii*. Ironically, Fletcher soundly discounted the possibility that *T. heathii* represented an aberration of a known thecline, remarking "I can hardly think that it is a suffused albinic variety of any of them." Aberrant individuals of the Theclinae which possess exaggerated ventral white pattern elements are thus loosely termed "heathii" aberrations. A number of North American and European "heathii" phenotypes have been figured in the literature (e.g., Frohawk 1938, Muller 1976, Fisher 1976, Russwurm 1978, Baggett 1983, Ferris 1992). Fisher (1976) figured a "heathii" aberration of *Mitoura grynea castalis* (W. H. Edwards) from Texas. Ferris (1992) discussed and figured "heathii" aberrations of a related species of *Mitoura* (attributed to *barryi* Johnson). A "heathii" aberration of the Floridian subspecies *M. g. sweadneri* F. H. Chermock is herein reported for the first time.

On 23 September 1992, a male "heathii" phenotype of *M. g. sweadneri* (Figs. 1 & 2) was captured on the blossoms of *Bidens alba* (L.) DC (Asteraceae) at Yankeetown, Levy Co., Florida. The dorsal wing surfaces of the individual appear normal. In contrast, the ventral wing surfaces are extremely modified and asymmetrical. The postmedian bands of the forewings are reduced to several indistinct triangular subapical spots. The white postmedian bands of the hindwings are broken into rows of rounded spots in cells Cu_2 , Cu_1 and M_3 . These spots are surrounded by the remnants of the inner red bands. The red and white linear markings normally present in cells $2A$ are entirely lacking. Between veins M_3 and $SC+R_1$, the postmedian bands are enlarged and fused, becoming most pronounced in cells $SC+R_1$. The marginal white lines on the hindwings are expanded inwardly and transformed into rounded patches. In addition, the hindwings are disproportionately small in size. The ventral hindwing pattern of the aberrant *M. g. sweadneri* is similar in configuration to the "heathii" of *M. g. castalis* figured by Fisher (1976).

Fisher (1976) briefly speculated on the genetic and/or physical origin of the "heathii" aberration. Ferris (1992) suggested that this type of aberration may be the result of the expression of a homologous allele found in many theclines. Nijhout (1991) proposed that all the aberrations figured by Russwurm (1978), including two "heathii" phenotypes, are probably the result of temperature shock rather than recurring mutation. Environmental stress, such as temperature shock, has been shown to produce a variety of pattern aberrations (see Nijhout 1991). Additional research is required to more fully understand the cause of this intriguing abnormality.